

Part A- Multiple Choice 13 marks
Attempt Questions 1-13
Allow about 10 minutes for this part

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

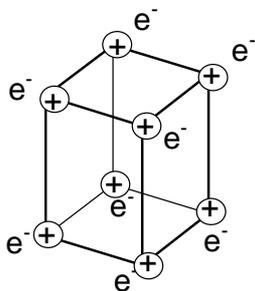
A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow as follows.

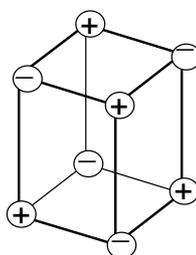
A B C D
correct ↙

▶ **Mark your answers for Questions 1- 13 in the Answer Box on page 7**

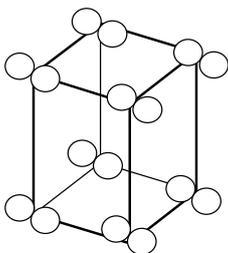
1. What type of bonding is shown by the structures given below?



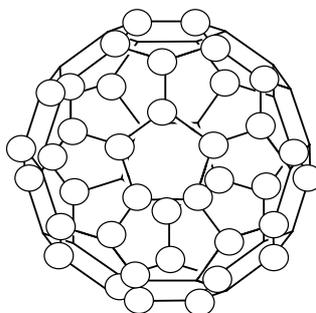
X



Y



Z



W

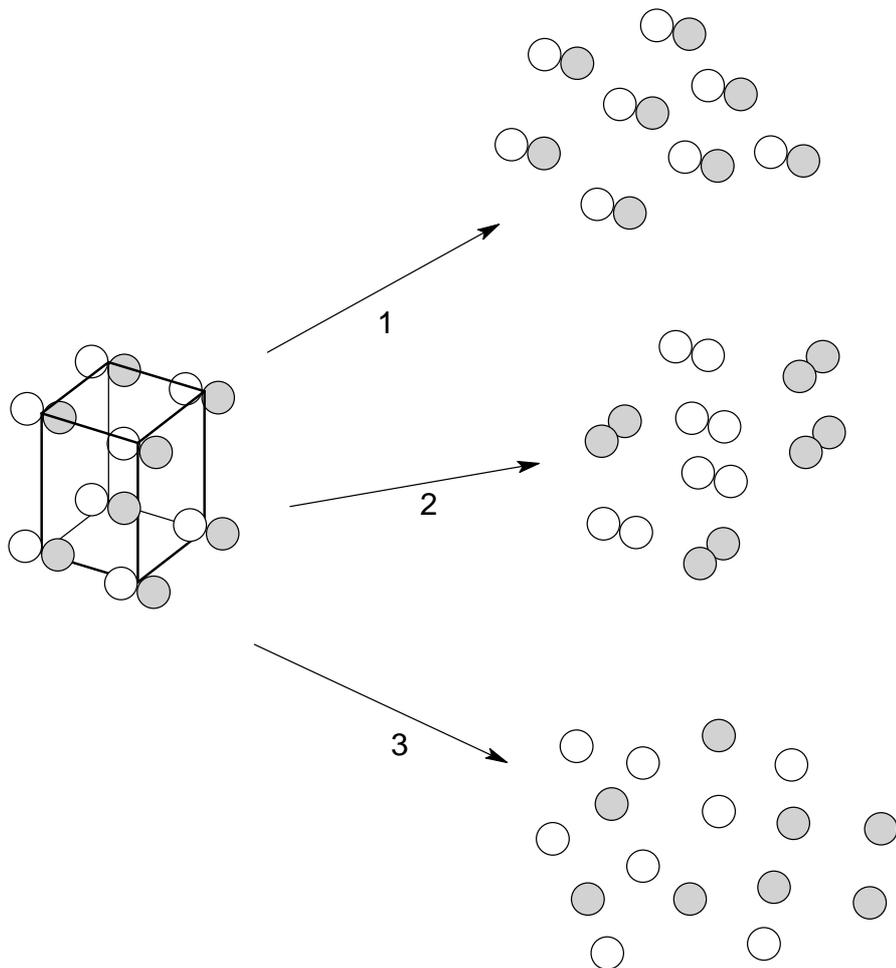
	<i>Ionic</i>	<i>Covalent</i>	<i>Metallic</i>
(A)	Y	Z	X
(B)	Y	W	Z
(C)	X	Z	Y
(D)	Z	W	Y

2. Which is the correct name for the following compound?



- (A) iron(II) oxide
- (B) iron(III) oxide
- (C) iron oxide
- (D) diiron trioxide

3. Which of the following processes is a chemical change?



- (A) 1, 2 and 3
- (B) 2 and 3 only
- (C) 1 and 3 only
- (D) 3 only

4. Why are the halogens placed together in the same group of the periodic table?
- (A) They are all diatomic gases
 (B) They have the same number of electrons in their atoms
 (C) They have similar chemical properties.
 (D) They are all non-metals.
5. Which of the following properties increases as one moves from left to right in period 2 of the periodic table?
- (A) Boiling point
 (B) Metallic character
 (C) Ionisation energy
 (D) Atomic radius
6. The table shows information about the chemical content of the Earth's spheres. Which sphere contains incorrect information?

	<i>Sphere</i>	<i>Chemical content (incomplete)</i>
(A)	atmosphere	argon, water
(B)	biosphere	DNA, coal
(C)	hydrosphere	water, oxygen
(D)	lithosphere	sand, bauxite

7. Which of the following has the same electronic configuration as a chloride ion, Cl^- ?
- (A) bromide ion, Br^-
 (B) argon atom, Ar
 (C) hydride ion, H^-
 (D) sodium ion, Na^+

8. The table contains descriptions of the physical properties of four elements.
Which element is a metal?

	<i>Element description</i>
(A)	Black, brittle, good electrical conductor, very high melting point
(B)	Pale colour, low density, soft, insulator
(C)	Lustrous, brittle, dense, very hard, weak electrical conductor
(D)	Shiny, malleable, high melting point, excellent conductor of heat

9. What is the name of the alloy made of approximately 70% copper and 30% zinc?

- (A) brass
- (B) bronze
- (C) solder
- (D) steel

10. Which of the following alloys has the lowest melting point?

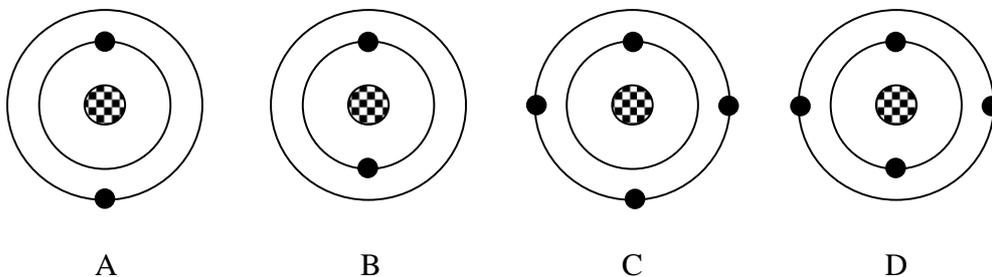
- (A) brass
- (B) bronze
- (C) solder
- (D) steel

11. Which of the following represents the composition of a fluoride ion?

	<i>protons</i>	<i>neutrons</i>	<i>electrons</i>
(A)	8	10	9
(B)	9	10	10
(C)	10	9	11
(D)	19	9	20

12. Which diagram shows the electron energy levels for a helium atom?

 nucleus ● electron



- (A) A
- (B) B
- (C) C
- (D) D

13 The newly synthesised element, Ruseium has the following properties:

<i>Temperature (°C)</i>	0	50	100
<i>Pressure (kPa)</i>	100	100	100
<i>State</i>	solid	liquid	gas

How would a chemist classify Ruseium at standard laboratory conditions?

- (A) solid
- (B) liquid
- (C) gas
- (D) aqueous

Student No.

Part A: Answer grid for multiple choice questions.

Total/ 13

1.	A O	B O	C O	D O
2.	A O	B O	C O	D O
3.	A O	B O	C O	D O
4.	A O	B O	C O	D O
5.	A O	B O	C O	D O
6.	A O	B O	C O	D O
7.	A O	B O	C O	D O
8.	A O	B O	C O	D O
9.	A O	B O	C O	D O
10.	A O	B O	C O	D O
11.	A O	B O	C O	D O
12.	A O	B O	C O	D O
13.	A O	B O	C O	D O

Part B. 43 marks

Attempt Questions 14 - 24

Allow about 60 minutes for this part

▶ Show all relevant working in questions involving calculations.

Question 14 (3 marks)

The table is a summary of the reactivity of some metals in water, steam at 100 °C and acid.

<i>element</i>	<i>element + water</i>	<i>element + steam</i>	<i>element + acid</i>
Li	<i>Y</i>	<i>Y</i>	<i>Y</i>
K	<i>Y</i>	<i>Y</i>	<i>Y</i>
Ba	<i>Y</i>	<i>Y</i>	<i>Y</i>
Sr	<i>Y</i>	<i>Y</i>	<i>Y</i>
Ca	<i>Y</i>	<i>Y</i>	<i>Y</i>
Na	<i>Y</i>	<i>Y</i>	<i>Y</i>
Mg	<i>N</i>	<i>Y</i>	<i>Y</i>
Al	<i>N</i>	<i>Y</i>	<i>Y</i>
Mn	<i>N</i>	<i>Y</i>	<i>Y</i>
Zn	<i>N</i>	<i>Y</i>	<i>Y</i>
Cr	<i>N</i>	<i>Y</i>	<i>Y</i>
Fe	<i>N</i>	<i>Y</i>	<i>Y</i>
Ni	<i>N</i>	<i>N</i>	<i>Y</i>
Sn	<i>N</i>	<i>N</i>	<i>Y</i>
Pb	<i>N</i>	<i>N</i>	<i>Y</i>

Legend: *Y* = reacts; *N* = does not react.

Explain the relative activities of the metals displayed in the table. **(3 marks)**

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Question 15 (2 marks)

Write half-equations to describe the reaction of magnesium with dilute sulfuric acid.

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Question 16 (5 marks)

From your study of the periodic table, identify the elements in the following list that would have the greatest similarity in both chemical and physical properties and justify your choice.

Ca, Na, Al, Ba, Cl, C

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Question 17 (3 marks)

The table shows the formation of magnesium oxide.

Complete this table by drawing the Lewis electron dot structures...

(3 marks)

Magnesium atom	+	Oxygen atom	→	Magnesium oxide

Question 18 (4 marks)

The illustration shows a rare sample of native (uncombined) copper found in Cornwall, England in 1797...



- (a) Explain why native copper is very rare, but copper ores (in the form of sulfides and carbonates) are quite common. **(1 mark)**

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(b) Write the formulas for copper(I) sulfide and copper(II) carbonate. **(1 mark)**

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(c) Account for the use of copper as electrical wire based on two of its physical properties. **(2 marks)**

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Question 19 (3 marks)

Karol is given a mixture containing pepper, sugar and water. She separates the mixture using filtration and evaporation techniques. She records this data during the separation...

Mass of mixture before separation	205.45 g
Mass of filter paper	1.33 g
Mass of conical flask	56.34 g
Mass of filter paper + pepper (dried)	4.57 g
Mass of conical flask + sugar (dried)	101.92 g

Calculate the mass percentage of pepper, sugar and water in the original mixture. **(3 marks)**

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Question 20 (6 marks)

Analyse the relationship between electrical conductivity and structure for the following solids:
sodium chloride, magnesium and diamond. (6 marks)

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Question 21 (3 marks)

Complete the table by giving the name or the formula of the substance. (3 marks)

<i>Name</i>	<i>Formula</i>
nitrogen monoxide	
zinc sulfate	
calcium fluoride	
	Cl ₂ O ₇
	NaHCO ₃
	NH ₃

Data Processing (10 marks)

Question 23 (5 marks)

Atoms can be arranged into a variety of structures. Models can be used to explain these structures. Discuss the advantages and disadvantages of using models to show the structure of covalent lattices.

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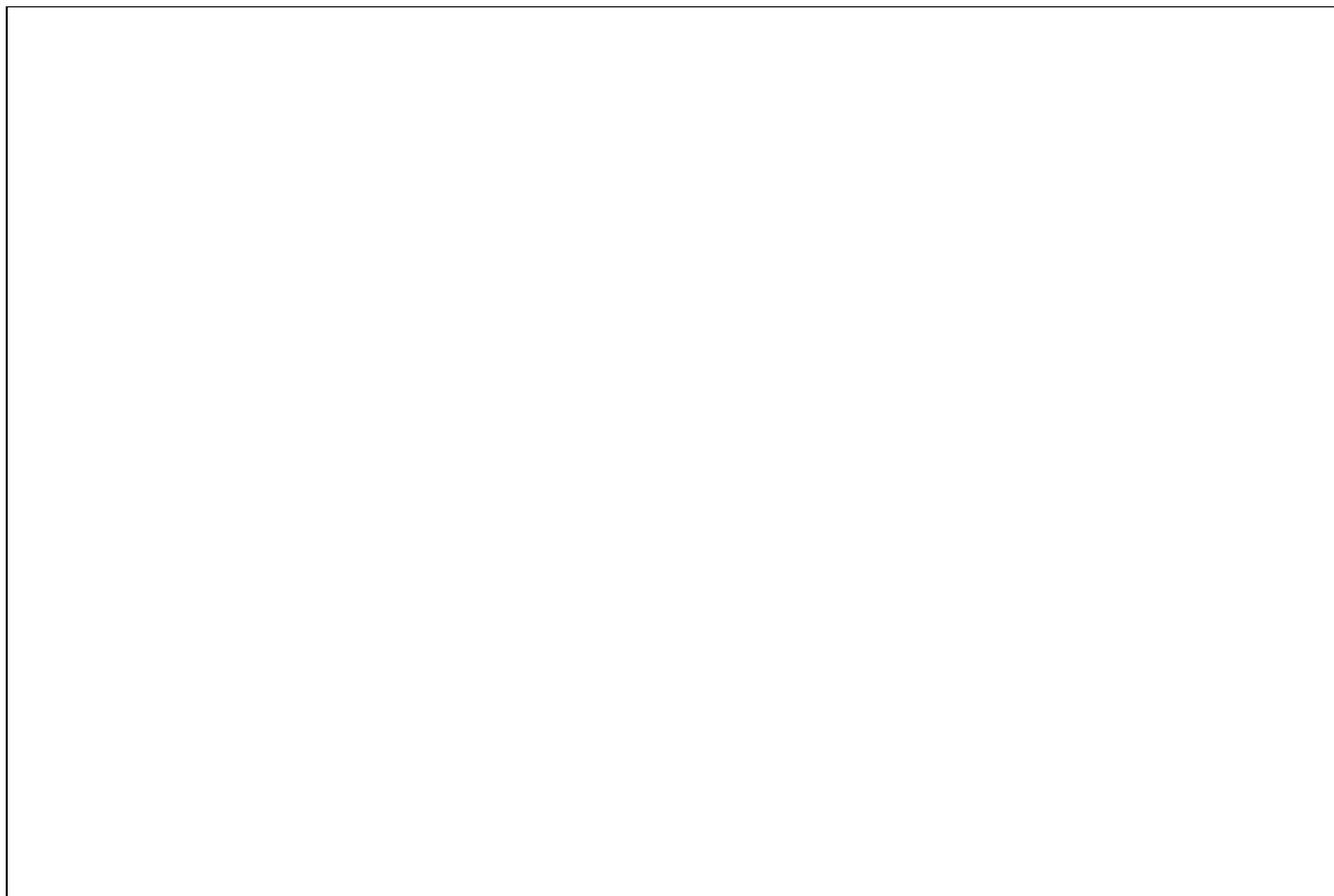
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Question 24 (5 marks)

Copper is extracted from ores such as malachite ($\text{Cu}_2\text{CO}_3 \cdot \text{Cu}(\text{OH})_2$). First the rock is crushed and the mineral extracted using froth flotation. The mineral is then roasted to convert carbonates to oxides. It is then smelted with carbon to convert the oxide to metal.

Construct a flow chart to show the steps in this process. Identify the four steps as physical or chemical separations/processes.



End of Test 

Part A- Multiple Choice 13 marks
Attempt Questions 1-13
Allow about 15 minutes for this part

Select the alternative A, B, C or D that best answers the question. Fill in the response oval completely.

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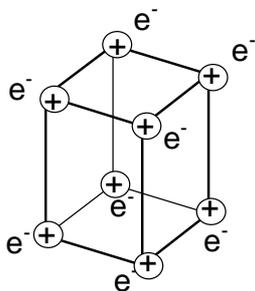
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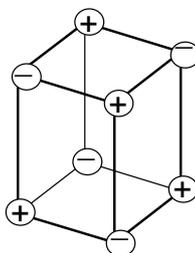
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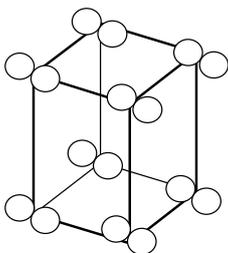
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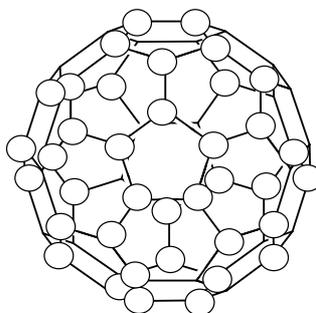
X



Y



Z



W

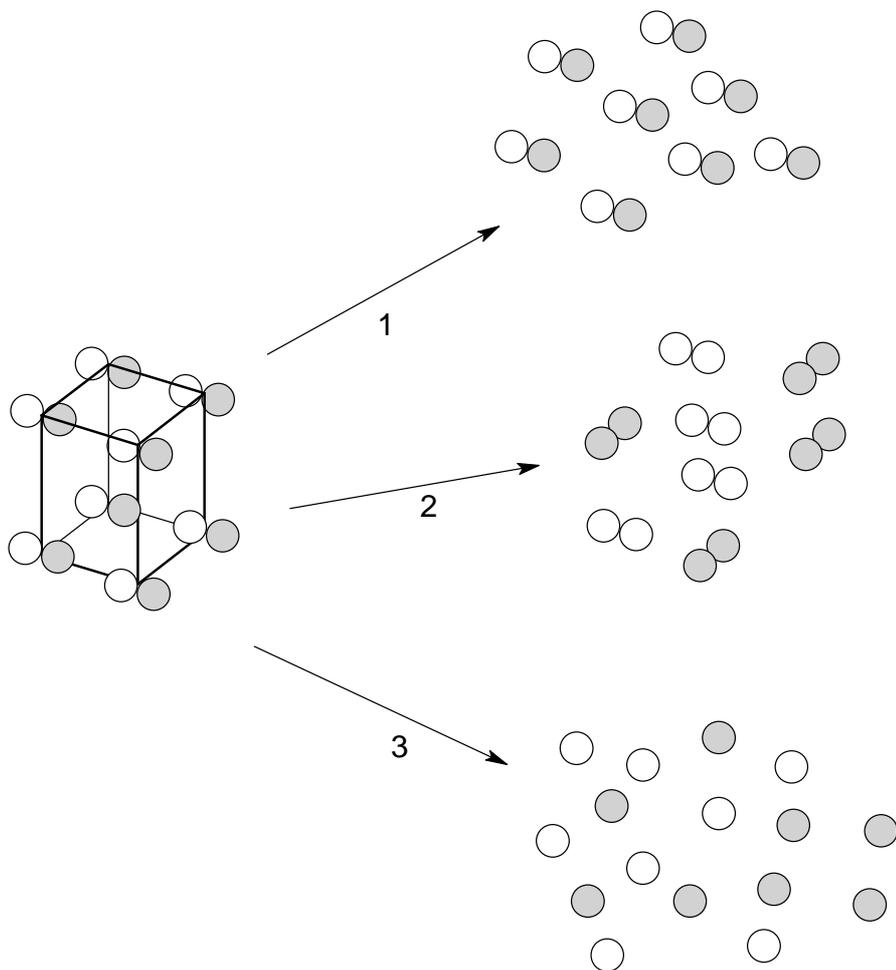
	<i>Ionic</i>	<i>Covalent</i>	<i>Metallic</i>
(A)	Y	Z	X
(B)	Y	W	Z
(C)	X	Z	Y
(D)	Z	W	Y

2. Which is the correct name for the following compound?



- (A) iron(II) oxide
- (B) iron(III) oxide
- (C) iron oxide
- (D) diiron trioxide

3. Which of the following processes is a chemical change?



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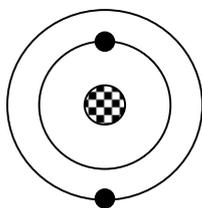
- (A) brass
- (B) bronze
- (C) **solder**
- (D) steel

11. Which of the following represents the composition of a fluoride ion?

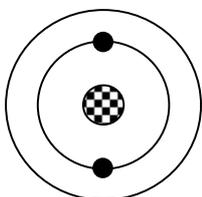
	<i>protons</i>	<i>neutrons</i>	<i>electrons</i>
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(D)	19	9	20

12. Which diagram shows the electron energy levels for a helium atom?

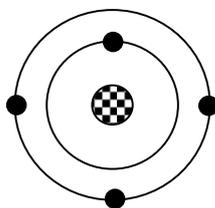
 nucleus ● electron



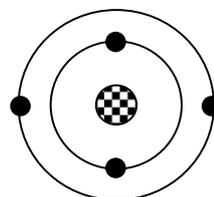
A



B



C



D

- (A) A
(B) **B**
(C) C
(D) D

Part A: Answer grid for multiple choice questions.

Total

1.	A O	B O	C O	D O
2.	A O	B O	C O	D O
3.	A O	B O	C O	D O
4.	A O	B O	C O	D O
5.	A O	B O	C O	D O
6.	A O	B O	C O	D O
7.	A O	B O	C O	D O
8.	A O	B O	C O	D O
9.	A O	B O	C O	D O
10.	A O	B O	C O	D O
11.	A O	B O	C O	D O
12.	A O	B O	C O	D O
13.	A O	B O	C O	D O

Part B. 43 marks

Attempt Questions 13 - 24

Allow about 55 minutes for this part

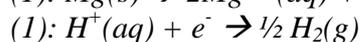
▶ Show all relevant working in questions involving calculations.

Question 14 (2 marks)

Write half-equations to describe the reaction of magnesium with dilute sulfuric acid.

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ANS.



Question 15 (3 marks)

The table is a summary of the reactivity of some metals in water, steam at 100 °C and acid.

<i>element</i>	<i>element + water</i>	<i>element + steam</i>	<i>element + acid</i>
Li	<i>Y</i>	<i>Y</i>	<i>Y</i>
K	<i>Y</i>	<i>Y</i>	<i>Y</i>
Ba	<i>Y</i>	<i>Y</i>	<i>Y</i>
Sr	<i>Y</i>	<i>Y</i>	<i>Y</i>
Ca	<i>Y</i>	<i>Y</i>	<i>Y</i>
Na	<i>Y</i>	<i>Y</i>	<i>Y</i>
Mg	<i>N</i>	<i>Y</i>	<i>Y</i>
Al	<i>N</i>	<i>Y</i>	<i>Y</i>
Mn	<i>N</i>	<i>Y</i>	<i>Y</i>
Zn	<i>N</i>	<i>Y</i>	<i>Y</i>
Cr	<i>N</i>	<i>Y</i>	<i>Y</i>
Fe	<i>N</i>	<i>Y</i>	<i>Y</i>
Ni	<i>N</i>	<i>N</i>	<i>Y</i>
Sn	<i>N</i>	<i>N</i>	<i>Y</i>
Pb	<i>N</i>	<i>N</i>	<i>Y</i>

Legend: *Y* = reacts; *N* = does not react.

Explain the relative activities of the metals displayed in the table. (3 marks)

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ANSWER

The more reactive metals have a lower first ionisation energy than the least reactive metals. Hence the more reactive metals tend to lose their valence electrons more easily than the least reactive metals. The more reactive metals of Li – Na react in water due to their greater reactivity than the other metals.

<i>Criteria</i>	<i>Mark</i>
describing the role of valence shell electrons in influencing reactivity.	1
stating more reactive metals have lower first ionisation energy than least reactive metals.	1
correct explanation of the role of ionisation energy in determining reactivity.	1

Question 16 (5 marks)

From your study of the periodic table, identify the elements in the following list that would have the greatest similarity in both chemical and physical properties and justify your choice.

Ca, Na, Al, Ba, Cl, C

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Answer:

Ca and Ba

The elements have the greatest similarity in chemical properties because they both have two electrons in their outer shell of electrons. They both have the same valency (or combining power) which is equal to 2 and are both reactive metals. They both form compounds with similar formulae eg their oxides CaO and BaO.

The elements also share similar physical properties. They are both silvery metals. They both conduct electricity and have high melting points and boiling points.

Marking Guidelines

Criteria	Marks
Correctly identifies Ca and Ba	1
Provides two similarities in their chemical properties	2
Provides two similarities in their physical properties	2

Question 17 (5 marks)

Atoms can be arranged into a variety of structures. Models can be used to explain these structures. Discuss the advantages and disadvantages of using models to show the structure of covalent lattices.

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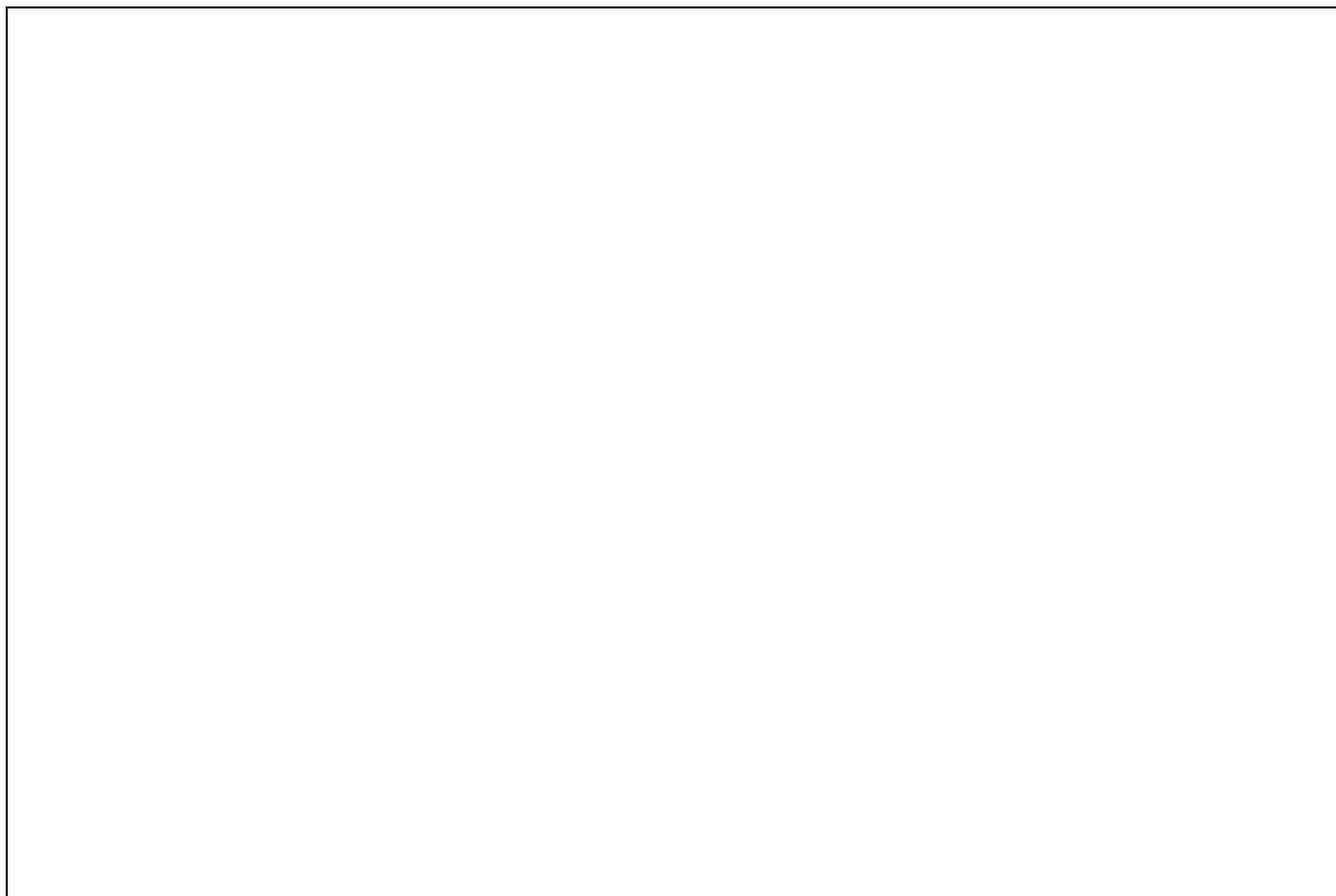
Answer (to be forwarded to you later)

Marking Criteria	Marks
Identifies an element (allotrope) or compound that exists as a covalent lattice and Discusses both advantages and disadvantages of models	4-5
Identifies an element (allotrope) or compound that exists as a covalent lattice and Describes an advantage or disadvantage of models	2-3
Identifies an element (allotrope) or compound that exists as a covalent lattice or Illustrates or describes the model used	1

Question 18 (5 marks)

Copper is extracted from ores such as malachite ($\text{Cu}_2\text{CO}_3 \cdot \text{Cu}(\text{OH})_2$). First the rock is crushed and the mineral extracted using froth flotation. The mineral is then roasted to convert carbonates to oxides. It is then smelted with carbon to convert the oxide to metal.

Construct a flow chart to show the steps in this process. Identify the four steps as physical or chemical separations/processes.



Answer

Rock (ore)

↓ crushing physical

smaller rock

↓ froth flotation physical

malachite

↓ roasting chemical

copper oxide

↓ smelting chemical

copper

Marking Criteria	Marks
Identifies 4 steps in a flow chart as physical and chemical changes/processes	5
Correct flow chart (4 steps) or 3 steps and identifies physical and chemical changes	4
Poor flow chart or Identifies 2 or 3 steps or Identifies physical and chemical changes	2-3
Identifies any step as physical or chemical	1

Question 19 (3 marks)

The table shows the formation of magnesium oxide.

Complete this table by drawing the Lewis electron dot structures...

(3 marks)

Magnesium atom	+	Oxygen atom	→	Magnesium oxide

Magnesium atom	+	Oxygen atom	→	Magnesium oxide
Mg :		$\begin{array}{c} \cdot \\ :O: \\ \cdot \end{array}$		$\text{Mg}^{2+} \begin{array}{c} \cdot\cdot \\ :O: \\ \cdot\cdot \end{array}^{2-}$

Question 20 (4 marks)

The illustration shows a rare sample of native (uncombined) copper found in Cornwall, England in 1797...



- (a) Explain why native copper is very rare, but copper ores (in the form of sulfides and carbonates) are quite common. **(1 mark)**

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Copper is too reactive to be commonly found as an uncombined element.

- (b) Write the formulas for copper(I) sulfide and copper(II) carbonate. **(1 mark)**

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- (c) Account for the use of copper as electrical wire based on two of its physical properties. **(2 marks)**

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***Copper is an excellent electrical conductor.
Copper is ductile and/or malleable and can readily be fabricated into wire and
hammered into shape.***

Question 21 (3 marks)

Karol is given a mixture containing pepper, sugar and water. She separates the mixture using filtration and evaporation techniques. She records this data during the separation...

Mass of mixture before separation	205.45 g
Mass of filter paper	1.33 g
Mass of conical flask	56.34 g
Mass of filter paper + pepper (dried)	4.57 g
Mass of conical flask + sugar (dried)	101.92 g

Calculate the mass percentage of pepper, sugar and water in the original mixture. **(3 marks)**

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$$\text{Pepper \%} = (4.57 \text{ g} - 1.33 \text{ g}) \div 205.45 \times 100 = 1.58\%$$

$$\text{Sugar \%} = (101.92 \text{ g} - 56.34 \text{ g}) \div 205.45 \times 100 = 22.19\%$$

$$\text{Water \%} = 100\% - 1.58\% - 22.19\% = 76.23\%$$

Question 22 (6 marks)

Analyse the relationship between electrical conductivity and structure for the following solids:
sodium chloride, magnesium and diamond. (6 marks)

ANS:

NaCl is an ionic solid and hence the particles (component ions are fixed in their lattice by an electrostatic force of interaction between the ions). The ions are not free to move and hence, NaCl does not conduct electricity. (2 marks)

Magnesium is composed of a lattice of cations in a “sea of delocalised” electrons. These electrons are able to conduct electricity through the solid. (2 marks)

Diamond is a covalent network solid composed of carbon atoms each bonded to four other atoms in a tetrahedral structure. There are no delocalised electrons or ions to carry the charge, hence, diamond does not conduct electricity. (2 marks)

For each of the solids queried...

Criteria(ion)	Mark(s)
Description of the structure	1
Linking of structure to electrical conductivity	1

Question 23 (3 marks)

Complete the table by giving the name or the formula of the substance.

Name	Formula
nitrogen monoxide	NO
zinc sulfate	ZnSO₄
calcium fluoride	CaF₂
dichlorine heptoxide	Cl ₂ O ₇
sodium hydrogen carbonate or sodium bicarbonate	NaHCO ₃
ammonia	NH ₃

